Foliar Disease Control in Field Pea in Southern Brazil

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Abstract

The introduction of field pea into the crop rotation in southern Brazil would diversify production and increase sustainability of the system. One of the main obstacles to field pea production in southern Brazil is the occurrence of foliar diseases. The objective of this project was to determine if field pea production potential could be maintained by application of fungicides during crop development to reduce the severity of diseases of field pea, particularly mycosphaerella blight and anthracnose. The study demonstrated that fungicide application effectively reduced severity of symptoms and maintained yield and quality. The single application of two combined active ingredients (pyraclostrobin and epoxiconazole) appeared to result in a synergy that proved to be the most effective treatment evaluated. Therefore, the use of fungicides with other integrated pest management practices such as early seeding and choice of a disease tolerant or less susceptible cultivar should help to maintain yield and quality of field pea in southern Brazil.

Introduction

The cropping system in the Planalto region of Rio Grande do Sul (RS) in southern Brazil usually consists of two crops per year. The most common crops seeded in the winter (June to November) are wheat, barley and oats, which are harvested in October or November. Summer crops include corn, soybean and blackbean, which are seeded between September to December and harvested in February to May. Dates of seeding and harvest vary somewhat with altitude (640 meters at Passo Fundo).

Due to high rainfall, diseases of cereals, particularly wheat and barley are prevalent. The diseases include fusarium head blight, leaf spots (septoria/ net blotch and spot blotch) and root diseases. The introduction of alternative crops such as broadleaved species, which are not susceptible to the same diseases as cereals could help to alleviate disease problems in wheat and increase productivity. As well as disease considerations, the inclusion of pulse crops would also increase sustainability of the system in terms of fertility. Field pea fixes nitrogen so no nitrogen fertilizer is required for the crop and a reduced amount of nitrogen fertilizer need be applied to the crop following field pea (eg. corn). Researchers and some progressive farmers in the area are already introducing alternative crops such as field pea and canola into their rotations. These crops not only increase the sustainability of the cropping system and benefit wheat production but are in demand from local markets.

Field pea is susceptible to a number of diseases, the most damaging of which is usually mycosphaerella blight and ascochyta foot rot. This disease is usually a complex of two fungal species *Mycosphaerella pinodes* (Berk. & Blox.) and *Phoma medicaginis* var. *pinodella* (Jones) Boerema. In some places or under some climatic conditions a third species *Ascochyta pisi* Lib., may also be involved (Hagedorn, 1984). The disease is favored by moist conditions during plant development. Field pea suffers from mycosphaerella blight in southern Brazil, as the crop does in most other areas of the world. Due to high rainfall (1750 mm annually) the disease often reaches epidemic proportions. Anthracnose, caused by *Colletotrichum pisi* Pat. is another disease of field pea, which in North America occurs sporadically and in localized areas and is considered of minor importance (Hagedorn, 1984). However under climatic conditions like those of southern Brazil (frequent precipitation, high humidity, and warm temperatures) the disease may be severe. Any wounding of pea plants, such as that caused by infection by *M. pinodes* or *P. medicaginis* var. *pinodella* aids infection of the plant by *C. pisi*, especially on pea stems (Hagedorn, 1984).

Work has been conducted at Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA) to determine if foliar diseases of field pea can be managed by manipulating seeding date and choice of cultivar. These factors are believed to be part of the IPM package for field pea production in southern Brazil but have been observed to be insufficient to reduce foliar disease damage to acceptable levels (Dr. G.O. Tomm, personal communication). The objective of this project was to determine if field pea production potential could be maintained by application of fungicides during crop development to reduce the severity of diseases, particularly mycosphaerella blight and anthracnose.

Experimental Method

This study was conducted at Passo Fundo, in the state of Rio Grande do Sul (RS) in southern Brazil ($28^0$15'S, $52^0$24'W). Average annual rainfall is 1763 mm with a June through November (wheat growing season) rainfall accumulation of 944 mm. The month with the lowest monthly precipitation is usually May (~100 mm) and the highest normally occurs in September (~200 mm). The highest mean monthly maximum temperature is 28.4^0C in January and the lowest mean minimum is 9.0^0C in July. Precipitation and temperature data for this study are summarized in Table 1.

The soil at the experimental sites was a dystrophic dark red latosol (Haplorthox), mapping unit Passo Fundo, predominantly clay. Rolling topography combined with highly erosive rains is common in the state of Rio Grande do Sul (RS) and most of Southern Brazil. Without plant cover, soil losses can be as high as 13 metric tons ha^{-1} over a 100-day period (Wünshe and Denardin, 1978).

Field experiments were established at Passo Fundo and Coxilha, RS. Coxilha is located 10 km west of Passo Fundo. Experiments were seeded June 24-26 in solid blocks of field pea (cv. Marjoret) with a commercial seed drill (Semeato SHM 13) to obtain a target plant population of 80 plants/m^2. Inoculant was not used but fertilizer (5-25-25) was applied at 390 kg/ha at Coxilha and 270 kg/ha at Passo Fundo. Illoxan (diclofop-methyl) was applied at 336 g.ai./ha to control ryegrass (*Lolium multiflorum*).

At each site the seeded area was divided into 5 replicates of 3 x 5 meters plots in a randomized complete block design. Fungicides were applied either singly or in combination once at the early flowering stage of plant development and for some treatments a second fungicide application was

made 19 days after the first application (Tables 2 & 3). One treatment consisted of three fungicide applications (mancozeb, chlorothalonil, pyraclostrobin). Fungicide treatment dates were September 26, October 3 and October 15.

Ten plants per plot were evaluated at BBCH growth stage 75 (50% of pods have reached final length) (Lancashire et al., 1991). Two disease assessment measurements were made, the first used a foliar rating scale to assess the amount of leaf and stem tissue with symptoms on a 0-9 scale (0 – no symtoms, 9 - all leaves and stems covered with symptoms and necrotic tissue), and a second assessed the amount of damage to the lower stem of each plant (Wang, 1998). Experiments were hand harvested on November 5 and 6 and threshed after drying.

Results and Discussion

Field pea plants in both experiments had only trace levels of disease infection by mycosphaerella blight at time of first fungicide application (early flower, BBCH growth stage 61) on September 25, 2002. However, at the time of disease evaluation (October 18, 2002) mycosphaerella blight infection was very high and symptoms of anthracnose were also readily observed in check plots and to varying degrees in most other treatments.

Visual assessment of field plots on October 17th indicated that only one treatment at either experimental site was having a consistent and marked effect on the diseases. This treatment consisted of a single application of the combined active ingredients pyraclostrobin and epoxiconazole (Figure 1). The application of pyraclostrobin or epoxiconazole singly did not appear to be as effective at reducing disease symptoms as the combined use of the chemicals. In Brazil, the trade name of this product is Opera, marketed by BASF company, for control of foliar diseases of wheat. Active ingredients registered for use in field pea or used experimentally in the Canadian prairies (mancozeb, chlorothalonil and azoxystrobin) appeared to have limited impact on mycosphaerella blight or anthracnose under the experimental conditions at Passo Fundo, in 2002.

Statistical analyses confirmed most of the observations from the field. At Coxilha the combined single application of pyraclostrobin + epoxiconazole dramatically reduced the symptoms of disease on both the foliage and the lower stem of each plant compared to the check or any other treatment (Table 2). None of the other treatments by either assessment method were different from the check. Results at the Passo Fundo site were not quite as dramatic but again the pyraclostrobin + epoxiconazole treatment had less disease symptoms than the check (Table 3). At Passo Fundo the single application of pyraclostrobin alone was similar to the combined pyraclostrobin + epoxiconazole treatment.

In terms of yield and thousand kernel weight (TKW) analyses of variance revealed a high degree of variation in the data at both sites but the trend was to greater yield and TKW with the pyraclostrobin + epoxiconazole treatment than other single application treatments (Tables 2 & 3). At Passo Fundo this treatment was greater than the check for both yield and TKW.

The data suggests a synergistic effect between the combined active ingredients pyraclostrobin + epoxiconazole when applied in a single application. The trend in both experiments was to less disease damage and increased yield and TKW in the combined treatment compared to the check or to application of either product alone. This synergistic effect has also been noted in the control of leaf spot diseases of wheat at Passo Fundo (Dr. Maurício Fernandes, personal communication).

The use of the contact or protectant fungicide chlorothalonil as a first fungicide application, followed by a second application with a partially systemic product such as pyraclostrobin was not effective in reducing disease symptoms or increasing yield or quality in either experiment (Tables 2 & 3). Similar to this treatment, the application of 3 different fungicides in 3 applications, using protectant products as the first two applications (mancozeb and chlorothalonil) and pyraclostrobin as the third did not reduce disease symptoms or increase yield or quality. Use of a semi-systemic product (pyraclostrobin or pyraclostrobin + epoxiconazole) before significant disease development appeared to be the best strategy under the experimental conditions in this study. Application of semi-systemic products as a second fungicide application appeared to have been too late to affect disease progression.

This study demonstrated that fungicide application to field pea in southern Brazil is effective for reduction of foliar diseases and for maintenance of yield and quality. The use of fungicides with other integrated pest management practices such as early seeding and choice of a disease tolerant or less susceptible cultivar should help to maintain yield and quality of field pea in southern Brazil.

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Table 1. Precipitation and temperature at Passo Fundo, RS in 2002.

Month	Precipitation (mm)		Temperature (^{o}C)	
	Normal (30 year mean)	2002	Minimum	Maximum
June	129	242	9.3	18.6
July	153	146	8.6	18.2
Aug.	166	234	11.3	20.4
Sept.	207	254	9.1	20.0
Oct.	167	372	14.8	24.1

Source of information: http://www.cnpt.embrapa.br/agromet.htm

Table 2. Effect of fungicide treatments on foliar disease symptoms on field pea (cv. Marjoret) at Coxilha, RS BRAZIL. Data are means of 5 replicates.

First fungicide application	Grams active ingredient per ha	Second fungicide application at 19 days after first application	Grams active ingredient per ha	Disease assessment of foliage (0-9)	Disease assessment of lower stems (0-9)	Yield kg/ha	TKW grams
Azoxystrobin	100	-		8.2 a†	7.3 a	571 a b	149 a b
Pyraclostrobin	100	-		6.8 a b	5.4 a b	661 a b	168 a b
Tryfloxystrobin	100	-		7.2 a	5.9 a b	701 a b	158 a b
Tryfloxystrobin + propiconazole	62.5 + 62.5	-		8.3 a	7.8 a	288 b	137 b
Mancozeb	1875	Pyraclostrobin	100	7.4 a	6.4 a b	778 a b	169 a b
Difenconazole	75	Azoxystrobin	100	7.0 a b	6.2 a b	653 a b	160 a b
Tebucoazole	125	Tryfloxystrobin	100	7.3 a	6.0 a b	709 a b	171 a b
Epoxiconazole	94	-		7.5 a	6.4 a b	760 a b	165 a b
Chlorothalonil	1126	Pyraclostrobin	100	7.1 a	5.9 a b	721 a b	167 a b
Pyraclostrobin + epoxiconazole	100 + 37.5	-		4.5 b	3.0 b	1028 a	191 a
Mancozeb / chlorothalonil *	1875 / 1126	Pyraclostrobin	100	7.3 a	6.7 a b	639 a b	163 a b
Check				8.3 a	7.3 a	650 a b	161 a b

Table 3. Effect of fungicide treatments on foliar disease symptoms on field pea (cv. Marjoret) at Passo Fundo, RS BRAZIL. Data are means of 5 replicates.

First fungicide application	Grams active ingredient per ha	Second fungicide application at 19 days after first application	Grams active ingredient per ha	Disease assessment of foliage (0-9)	Disease assessment of lower stems (0-9)	Yield kg/ha	TKW grams
Azoxystrobin	100	-		7.3 a b c†	6.1 a b c	824 a b	157 c
Pyraclostrobin	100	-		5.8 b c	4.4 c	948 a b	175 a b
Tryfloxystrobin	100	-		7.2 a b c	6.2 a b c	952 a b	166 a b c
Tryfloxystrobin + propiconazole	62.5 + 62.5	-		7.7 a	6.9 a	919 a b	157 c
Mancozeb	1875	Pyraclostrobin	100	7.4 a b	6.7 a b	703 b	155 c
Difenconazole	75	Azoxystrobin	100	6.3 a b c	5.1 a b c	1004 a b	176 a
Tebucoazole	125	Tryfloxystrobin	100	7.1 a b c	6.0 a b c	880 a b	168 a b c
Epoxiconazole	94	-		7.0 a b c	5.8 a b c	1014 a b	168 a b c
Chlorothalonil	1126	Pyraclostrobin	100	7.8 a	6.6 a b c	743 b	159 b c
Pyraclostrobin + epoxiconazole	100 + 37.5	-		5.6 c	4.6 b c	1147 a	180 a
Mancozeb / chlorothalonil *	1875 / 1126	Pyraclostrobin	100	7.4 a b c	6.3 a b c	1029 a b	166 a b c
Check				7.9 a	7.0 a	724 b	152 c

* chlorothalonil was applied 8 days after after mancozeb for this treatment.

† means followed by the same letter are not significantly different according to Tukey's test at P = 0.05.

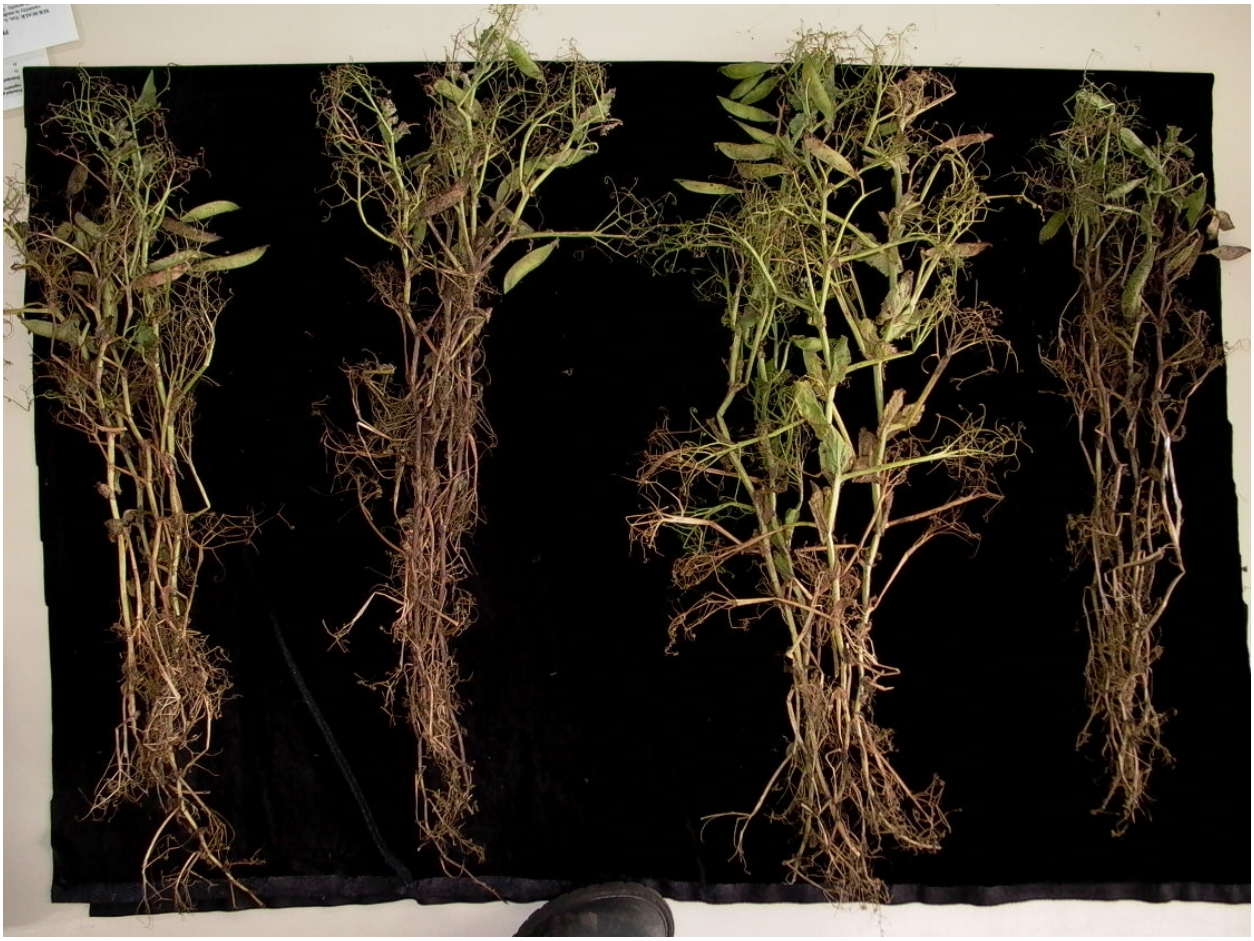

Figure 1. Effect of fungicides on field pea plants at time of disease evaluation. Treatments from left to right: pyraclostrobin, epoxiconazole, pyraclostrobin + epoxiconazole, check.